

REMARKS

Claims 1-9, and 11-18 are pending in the present Application. No claims have been canceled, amended, or added, and Claims 1-3 are withdrawn, leaving Claims 4-9 and 11-18 for consideration upon entry of the present amendment.

The Applicants again sincerely wish to thank the Examiner for the allowance of Claims 16-18. Applicants believe, however, that in light of the remarks below, the Examiner will also find the remaining pending claims to be allowable as well.

Reconsideration and allowance of the claims are respectfully requested in view of the above amendments and the following remarks.

Claim Rejections Under 35 U.S.C. § 103(a)

Claims 4-9 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over U.S. Patent No. 6,699,330 (“Muraoka”) in view of U.S. Patent No. 6,982,006 (“Boyers”). Applicants respectfully traverse this rejection.

Muraoka discloses a method of stripping surface-deposited organic contaminants such as e.g., novolak resist and DOP (i.e., dioctyl phthalate, also referred to as 2-ethylhexyl phthalate), using a stripping composition of an organic solvent with a partition coefficient of 0.6 toward ozone, where the ozone is *dissolved* in the solvent. Col. 4, lines 6-12; emphasis added. Acetic acid is used as the organic solvent. Col. 4, lines 25-29; col. 6, lines 57-66. The stripping composition is used as a “running film” over the surface to be stripped, and is replenished constantly or at intervals. Col. 4, lines 13-23. Muraoka teaches that the ozone concentration may be 100 ppm or higher in the stripping solution, and discloses ozone values of 280 ppm and 220 ppm for acetic acid stripping solutions which decreases with decrease in acetic acid concentration. Muraoka, Col. 6, lines 33-37; FIG. 6. Muraoka also teaches bubbling ozone through glass filter into the solution to reach a concentration close to saturation, and with enhancement, “up to nearly 400 ppm”. Col. 7, 24-27. It will be appreciated by one skilled in the art that “nearly 400 ppm” thus represents a practical upper limit for a saturated solution ozone concentration required by the disclosure of Muraoka. Muraoka shows data that correlate stripping rate and ozone concentration to concentrations of acetic acid of 50 to 100 wt%. FIG 6, x-axis.

Boyers discloses a *supersaturated* aqueous solution of ozone in water for use as a stripping

composition. Boyers, e.g., Col. 22, lines 32-36. The concentration of ozone in the saturated solution is calculated according to Henry's Law, and is disclosed in Table 1 in units of mg/L (i.e., ppm weigh per unit volume), where the maximum concentration of ozone dissolved in water at 5°C at 4 bars pressure is 436 mg/L (i.e., 436 ppm per unit weight). Col. 6, lines 29-45; Table 1. The method of Boyers involves delivery of a saturated aqueous ozone solution to a surface via dispense through a point-of-use heater to provide the stripping solution at a higher temperature of about 50°C (i.e., a *supersaturated* solution) to provide greater stripping capability (by the higher temperature and higher ozone concentration); by keeping the time interval between heating and contact of the saturated ozone solution with the surface to be treated as short as possible (e.g., about 2 seconds), the solution has minimal time to equilibrate and loses only 10-20% of the ozone during dispense. Col. 13, line 51 to Col. 14, line 32. A hydroxy radical scavenger may be added to the stripping solution, including a carboxylic acid such as acetic acid, and the scavenger is injected just prior to the point-of-use heater at a flow of about 1 mL/sec into an ozone water solution flowing at about 50 mL/sec, to provide a hydroxyl radical scavenger concentration of about 20 mmol/L. Col. 20, lines 41-55 and 56-67; Col. 21, lines 1-2. The duration of contact of the hydroxyl radical scavenger with the solution is kept to a minimum to minimize reaction of the scavenger with the ozone. Col. 22, lines 19-42.

For an obviousness rejection to be proper, the Examiner must meet the burden of establishing that all elements of the invention are disclosed in the prior art; that the prior art relied upon, or knowledge generally available in the art at the time of the invention, must provide some suggestion or incentive that would have motivated the skilled artisan to modify a reference or combined references. *In re Fine*, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988). “A patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1741 (2007). To find obviousness, the Examiner must “identify a reason that would have prompted a person of ordinary skill in the art in the relevant field to combine the elements in the way the claimed new invention does.” *Id.*

Muraoka and Boyers fail to disclose all elements of the instant claims, and furthermore there is no suggestion or incentive in either Muraoka or Boyers that would lead one to combine the references to provide the stripping composition and method of the instant Claim 4, with a

reasonable expectation for success.

Regarding the combination of Muraoka in view of Boyers, Muraoka does not disclose a pH of 1.6 to 5 as claimed in instant Claim 4, while Boyers discloses that the optimum pH for minimizing metal corrosion is slightly less than 7, and that normalized etch rate for a positive photoresist at pH of 4.2 is about one-tenth of the etch rate obtained at higher pH of 6-7. Boyers, Col. 18, lines 4-18. One skilled in the art will appreciate that a higher etch rate is generally more desirable than a lower etch rate, as a higher etch rate implies reduction in processing time, greater throughput, and increased manufacturing efficiency. In accord with this, Boyer teaches a pH of 6.7, which is roughly comparable to pH of 7 and would be expected to provide an increased etch rate. However, the pH of the invention as claimed is from 1.6 to 5, which is not taught by Muraoka or Boyers. Also, because of the teachings and implications of Boyers, there is no suggestion or incentive present in either of these references to modify the pH of the composition to obtain a pH of 1.6 to 5 as claimed, where in fact the teachings of Boyers point away from reducing the pH and toward an increased pH based on the expectation of a higher etch rate. Therefore, Muraoka in view of Boyers fails to teach all limitations of the instant claims, and fails to provide a suggestion or incentive that would lead one skilled in the art to modify the combination to provide the claimed pH range of 1.6 to 5 as claimed in Claim 4.

Further, Muraoka as noted above does not disclose a pH for the solvent, and does not disclose how such a property would be obtained since the solutions of Muraoka are organic. As disclosed in the Specification on p. 11, lines 11-18, the pH of the acetic acid in the stripping composition of the present invention exists in the range of about 1.6 to about 5. In an exemplary embodiment, the acetic acid used in the stripping composition of the instant invention has a pH of 2. See Specification, p. 14, lines 5-6. It is disclosed in the instant Specification that photoresist may be lifted off by the ozone under a strong acidic atmosphere, and the photoresist is transformed to a carboxylic acid by the ozone so that oxidation-reduction potential is no less than about 1V while the pH is no more than about 5. Muraoka is silent as to these teachings and cannot therefore provide a suggestion or incentive that would lead one skilled in the art to modify Muraoka to provide these limitations. Boyer does disclose that pH (which is accepted in the art as a measure of hydrogen ion concentration in *aqueous* systems) is a variable that can be adjusted to provide selective etch. However, Muraoka discloses a non-aqueous solution of acetic acid, ozone,

and optionally a nonpolar organic solvent (but not water). Boyers, on the contrary, discloses an aqueous ozone solution that may have its pH adjusted. Muraoka thus teaches use of an organic solvent free of water, where Boyers teaches an aqueous solvent. These are not compatible systems. Even assuming that all elements of an invention are disclosed in the prior art, an Examiner cannot establish obviousness by locating references that describe various aspects of a patent applicant's invention without also providing evidence of the motivating force which would have impelled one skilled in the art to do what the patent applicant has done. *Ex parte Levengood*, 28 U.S.P.Q.2d 1300 (Bd. Pat. App. Int. 1993). Because Muraoka does not extend to aqueous solutions, and hence teaches that water is not desirable, and that a nonpolar solvent is used in the stripping composition of Muraoka, there can be no suggestion or incentive that would lead one to include an aqueous solution of ozone in the invention of Muraoka, which would destroy the intent of the references. In this regard, the courts have held that “[i]f the proposed modification would render the prior art invention being modified unsatisfactorily for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon* 733 F. 2d 900, 221 USPQ 1125 (Fed. Cir. 1984). To include an aqueous solution, such as that of Boyers, in the method of Muraoka would defeat the purpose of Muraoka.

There is also no suggestion found in Muraoka and Boyers to combining these references, as the solvents disclosed in each teach away from the other. Muraoka discloses use of acetic acid, and a *non-polar* organic solvent. Col. 6, lines 8-10. Muraoka also expressly states that any solvent having a good partition coefficient can be used “as long as it is an *organic solvent*”, and discloses organic solvents including fatty acids (i.e., acetic, propionic, butyric acid) and dichloromethane. Col. 6, lines 22-32. Muraoka, also as noted previously, clearly discloses bubbling ozone through an acetic acid solution to prepare the solution with ozone present at up to the saturation point (i.e., about 400 ppm) but fails to disclose that the bubbles of the solution participate in the stripping process. The actual concentration of the ozone in the solution is 200-220 ppm. Boyer also specifically discloses providing a *saturated* solution of ozone in *water*, where the maximum possible saturation under the conditions used in Boyer is about 436 ppm, then heating during point-of-use dispense which creates a de facto *supersaturated* solution with only 10-20% loss of ozone (e.g., at best 393 ppm ozone) where otherwise allowing a heated solution to equilibrate the dissolved gases (ozone) would mean loss of a far greater percentage of

ozone; and incidentally including a hydroxyl scavenger (e.g., acetic acid) immediately prior to *heating and dispense*, in dilute form of 50:1 based on the aqueous ozone solution.

In contrast, the method of Muraoka, as noted previously, extensively discloses a flowing film solution process where a saturated solution of ozone in acetic acid, optionally with a nonpolar solvent included (*but not water*). Each of these processes diverges from each other, and individually or combined, is dramatically different from the process claimed by Applicants. Applicants process discloses a much higher concentration of ozone (Claim 6), in bubble form as claimed in Claim 1, where the ozone is present in an aqueous solution of acetic acid and water. This is conceptually completely different from the methods of Muraoka and Boyer, and cannot be taught by the combination.

Further, neither Muraoka nor Boyer disclose the use of ozone in bubble form in the stripping composition, and hence the combination does not disclose all elements of instant Claim 4. Each is amply clear that the solution containing ozone has the ozone present in a saturated (Muraoka) or supersaturated (Boyer) form, which by definition does not include bubbles. While Muraoka's process operates at ambient pressure and maintains ozone concentration near the saturation limit of about 400 ppm for an acetic acid/solvent solution (where the solvent is expressly non-aqueous!), Boyer discloses that supersaturation is maintained by dispensing immediately after heating so that the solution does not have time to equilibrate and form bubbles to release the dissolved ozone. It is amply clear that the principle of operation of Muraoka and Boyer, which are similar in that each depends upon use of a saturated ozone solution, is totally unlike that of the instant claims which as claimed in Claim 4, expressly uses a solution with bubbles of ozone therein. It would not be possible, based on the disclosures of Muraoka and Boyer which disclose maximum values of saturated ozone of about 400 and 436 ppm, to create a solution with the extremely high ozone levels (i.e., as claimed in instant Claim 6 of 80,000 to 90,000 ppm; over 200 times higher than in Boyers, and 300-400 times higher than in Muraoka) without the use of ozone in bubble form in the stripping solution as claimed in Claim 4.

Neither Muraoka nor Boyer disclose the use of ozone in bubble form, and because each explicitly and extensively discloses use of saturated or supersaturated ozone solutions, there cannot be even a remote possibility of a suggestion or incentive that would lead one skilled in the art of photoresist stripping to combine the saturated or supersaturated solutions of Muraoka and

Boyer, with ozone bubbles. To do so would completely change the principle of operation of each of these inventions, where each of Muraoka and Boyer is predicated on a smooth dispense on or across a wafer surface, where inclusion of bubbles would interfere with such a dispense and wash motif. The courts have held that ‘[i]f the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious.’” *In re Ratti* 270 F. 2d 810, 123 USPQ 349 (CCPA 1959). Inclusion of ozone bubbles would, one must appreciate, require a completely different dispense and stripping process for each of Muraoka and Boyers, in order to provide the method claimed in Claim 4. There is no suggestion or evidence in either of these references that doing so would be successful, and therefore Muraoka in view of Boyers fails to provide a suggestion or incentive that would lead one skilled in the art to modify the references to provide the process of Claim 4.

For at least these reasons therefore, Muraoka in view of Boyers thus fails to disclose all elements of the instant claim 4 and fails to provide a suggestion or incentive that would have led one skilled in the art to modify Muraoka, or Muraoka in view of Boyers, to provide the missing elements. Reconsideration and allowance of Claim 4 and its dependents is respectfully requested.

With regard to Claim 6, Muraoka discloses bubbling ozone through an acetic acid solution to prepare the solution with ozone present at up to the saturation point (i.e., about 400 ppm) but fails to disclose that the bubbles of the solution are present or participate in the stripping process, while on the contrary extensively disclosing a flowing film solution process with a dissolved (not bubble-form) ozone content, that is dramatically different from the process claimed by Applicants. As noted above, Boyers discloses at most an aqueous ozone concentration of 436 ppm. Hence Boyers fails to remedy the deficiencies of Muraoka with regard to Claim 6 as well.

Applicants specifically but respectfully traverse the Examiner’s statement that use of a high ozone concentration is mere optimization of conditions. MPEP 2144.05, referenced by the Examiner, deals with criticality of range and is generally applied where the range is close or overlapping. Such is not the case here; as noted above, the ranges of the cited art and that of the instant claim differ by two orders of magnitude, well above any arguable margin of optimization, and clearly indicative of a vastly different process and theory of operation (i.e., the use of saturated solution-phase ozone in the case of the cited references to achieve contact and transport

of the oxidant, compared to the transport and action of ozone *bubbles*, which are trapped localized free gas, on the wafer surface). In particular, this section of the MPEP also clearly states that “*A prima facie* case of obviousness may also be rebutted by showing that the art, in any material respect, teaches away from the claimed invention. *In re Geisler*, 116 F.3d 1465, 1471, 43 USPQ2d 1362, 1366 (Fed. Cir. 1997). As discussed extensively above, the actual method of removal of photoresist from the surface to be stripped in the cited art is accomplished by a saturated or supersaturated ozone solution (Muraoka and Boyers), but is accomplished as claimed in Applicants instant Claim 4 by “a stripping composition including an acetic acid and an ozone gas included in the acetic acid *in the form of a bubble*”. These are completely different stripping solutions, with completely different accompanying stripping methods and principles of operation, and consequently the cited references must be appreciated as being materially different in at least this respect from the claimed process. The cited art further differs in the methods of dispense, heat control, flow pattern, and equipment design, and consequently, cannot be considered to be so similar as to not differ materially. There can therefore be no reasonable expectation that combining these references, and further modifying the references to include ozone in bubble form, would have a reasonable expectation for success. Applicants respectfully request the Examiner reconsider the rejection of Muraoka in view of Boyer, in view of their divergent teachings, and withdraw the rejection.

Furthermore, as noted previously, Applicants observed a stripping rate of 6 $\mu\text{m}/\text{min}$ and that “the stripping rate of the stripping composition of the invention is greatly superior to that of the stripping composition including ozone and the ultra pure water”, which is essentially the composition of Boyers, and hence, there is evidence in Applicant’s instant Specification to show that the results achieved in the method of Claim 4 is unexpected over the stripping composition of a close comparative example, i.e., Boyers. The Applicants respectfully maintain therefore, that the unexpected stripping rate observed by the applicants supports a finding of nonobviousness. One skilled in the art will also appreciate that the superior results achieved by Applicants cannot therefore be mere optimization of parameters found in Muraoka and Boyers, as alleged by the Examiner but represents the application of a method dramatically different from that disclosed in Muraoka and Boyers. Applicant’s method is not taught in either of these references individually or combined, and hence there is no suggestion or incentive that would lead one skilled in the art to

modify the combination of Muraoka and Boyers to provide the stripping composition and method as claimed in instant Claim 4.

Thus for at least the above reasons, the combination of Muraoka and Boyers fails to teach all limitations of the instant claims, fails to provide a suggestion or incentive that would lead one skilled in the art to modify the combination of references to provide the invention of Claim 4, and fails to provide a reasonable expectation for success for the combination. Muraoka in view of Boyers therefore fails to render the instant claims 4-9 unpatentable. Reconsideration and allowance of the claims is respectfully requested.

Claims 11 and 12 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over Muraoka in view of Boyers, and further in view of U.S. Patent Application Publication No. 2003/0045037 (“Mei”). Applicants respectfully traverse this rejection.

Mei discloses a memory device with gate electrodes, which comprise Al/Cr. FIG. 11, ref. numeral 506.

Mei discloses CVD/PECVD deposition processes (e.g., [0094]), but is silent as to stripping process of Claim 4 and is in particular silent as to stripping compositions comprising acetic acid comprising ozone bubbles or to pH of the stripping composition, as claimed in the instant claims, and thus for reasons disclosed hereinabove, fails to remedy the deficiencies of Muraoka and Boyers. Thus, the combination of Muraoka, Boyers, and Mei fails to render the instant claims unpatentable.

Claims 13-15 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over Muraoka in view of Boyers, in view of Mei, and further in view of U.S. Patent Application Publication No. 2002/0088478 (“Degendt”). Applicants respectfully traverse this rejection.

Degendt discloses inclusion of chlorine in a stripping process. (e.g., Degendt, [0014], [0016], [0080]) but is silent as to stripping process of Claim 4 and is in particular silent as to stripping compositions comprising acetic acid comprising ozone bubbles or to pH of the stripping composition, as claimed in the instant claims, and thus for reasons disclosed hereinabove, fails to remedy the deficiencies of Muraoka and Boyers. Thus, the combination of Muraoka, Boyers, and Mei and Degendt fails to render the instant claims unpatentable.

It is believed that the foregoing amendments and remarks fully comply with the Office Action and that the claims herein should now be allowable to Applicants. Accordingly, reconsideration and allowance are requested.

If there are any additional charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130.

Respectfully submitted,

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